TOTAL PARENTERAL NUTRITION (TPN) – ADMINISTRATION IN ADULT WARD AREAS AND INTENSIVE CARE AT ST GEORGE HOSPITAL ONLY

<table>
<thead>
<tr>
<th>Cross references (including NSW Health/SESIAHS policy directives)</th>
<th>Guidelines for management of peripherally inserted catheters (PICCs) and centrally inserted central venous access devices (CICVAD) – CHN CLIN_058 Labelling injectable medicines, fluids &amp; lines – SGSHHS CLIN_191 Central Venous Access Device Insertion and Post Insertion Care – PD2011_060</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What it is</td>
<td>Clinical guidelines for the administration of TPN in Adult Ward areas, Intensive Care Unit (ICU) and High Dependency Unit (ICU-2)</td>
</tr>
<tr>
<td>2. Employees it applies to</td>
<td>Medical and nursing staff responsible for the care of patients receiving TPN</td>
</tr>
<tr>
<td>3. When to use it</td>
<td>Rule is to be used when patients require TPN in ICU, ICU-2 and ward areas</td>
</tr>
<tr>
<td>4. Why the rule is necessary</td>
<td>To ensure the appropriate and safe delivery of TPN</td>
</tr>
<tr>
<td>5. Who is responsible</td>
<td>ICU Consultants Clinical Nurse Consultants Nutritional Support Director of Intensive Care Services Director of Nursing</td>
</tr>
</tbody>
</table>
6. Process
Nutritional support (enteral and/or parenteral) should be considered for all patients who are malnourished or who are at risk of malnutrition. Where possible, oral and/or enteral nutrition are the preferred options. As parenteral nutrition (TPN) is an invasive and relatively expensive therapy, it must be used for specific clinical indications where there is clear evidence of benefit to the patient and in a manner which limits the risk of associated morbidity (sepsis, metabolic complications and catheter-related complications).

Care should always be taken not to overestimate the patient’s nutritional requirements. Significant risks are associated with overfeeding (increased infections, liver dysfunction, respiratory failure, hyperglycaemia, hyperlipidaemia, metabolic acidosis and other longer term complications).

6.1 Indications for TPN
General Indications for TPN
TPN may be indicated in the short term for patients who are malnourished or who are at risk of malnutrition and who have reversible loss of gastrointestinal function, i.e. the gastrointestinal tract cannot be accessed, is not functional because it is either obstructed, inflamed, fistulated or leaking, AND the patient cannot achieve adequate nutrition by oral or enteral means. Less commonly, where there is irreversible loss of alimentary function (e.g. short gut syndrome), TPN can be life saving and may be considered long term (including the delivery of home TPN).

Specific Clinical Situations

1. **Peri-operative nutritional support**: Patients who are identified as being severely malnourished pre-operatively AND who cannot be adequately fed via oral or enteral routes may benefit from 7-10 days of parenteral nutrition prior to surgery to improve post-operative outcomes (Braga 2009). Ideally, a minimum of 10-14 days of TPN is required to reduce the risk of post-operative morbidity (Buzby 1991). Its use in patients who are not malnourished or who only have mild malnutrition is associated with either no benefit or with increased morbidity, so patient selection is important.

2. **Patients with high-risk of prolonged post-operative ileus**: Post-operative TPN is recommended in patients who cannot meet their caloric requirements within 7-10 days via oral or enteral routes (Braga 2009). However, the early initiation of TPN after surgery (within 1 week) has been reported to be associated with increased rates of infection and health care costs (Casaer 2011) while providing early TPN to critically ill patients who would not otherwise receive nutrition support due to short-term contraindications to enteral feeding has not been shown to improve survival (Doig 2013). Therefore, the utility and timing of post-operative TPN should be guided by an assessment of risk/benefit based on the peri-operative nutritional state of the patient and the predicted post-operative clinical course.

3. **Pancreatitis and pancreatic fistula**: Patients with severe pancreatitis, its complications thereof or the need for surgery, benefit from early nutritional support. Jejunal feeding, via a naso-jejunal feeding tube or jejunostomy, is the preferred route for nutrition with improved outcomes compared to TPN (Abou-assi 2002, McClave 2006). Where this is not possible or inadequate within a period of 5-7 days, parenteral nutrition (enriched with glutamine) alone or combined with administration of an elemental or immuno-enhancing diet via the jejunum may be considered (Meier 2002, Dechelotte 2006). Jejunal feeding improves fistula closure rates and reduces time to fistula closure compared to TPN alone (Klek 2011).

4. **Palliative surgical and non-surgical oncology**: This is controversial and requires broad and extensive consultation. In patients with intestinal failure where enteral nutrition is insufficient and expected survival due to disease progression is longer than 3 months, long term TPN may be considered in motivated patients (Bozzetti 2009). However, TPN may not be appropriate in patients whose life expectancy is limited and when the goals of TPN (maintenance of adequate nutrition and improved patient outcomes) are unlikely to be realised. In these situations, TPN is an additional burden with significant potential risks.

Nutritional Screening
Assessment for TPN should include an assessment of individual nutritional risks and requirements, including the risk of refeeding syndrome. A complete assessment of the nutritional status of a patient by a dietitian should be undertaken prior to commencing TPN for all ward patients.
Definitions of malnutrition and risk of malnutrition

1. **Severe protein-energy malnutrition:** In adults, BMI < 18.5 kg/m² or unintentional loss of weight (≥10%) with evidence of suboptimal intake resulting in severe loss of subcutaneous fat and/or severe muscle wasting.

2. **Moderate protein-energy malnutrition:** In adults, BMI < 18.5 kg/m² or unintentional loss of weight (5–9%) with evidence of suboptimal intake resulting in moderate loss of subcutaneous fat and/or moderate muscle wasting.

3. **Mild protein-energy malnutrition:** In adults, BMI < 18.5 kg/m² or unintentional loss of weight (5–9%) with evidence of suboptimal intake resulting in mild loss of subcutaneous fat and/or mild muscle wasting.

4. **Risk of malnutrition:** In adults, defined by the present nutritional status and risk of impairment due to increased nutritional needs from causes such as catabolism, high nutrient losses or poor absorptive capacity, together with the absence of nutritional intake for more than 5 days (Kondrup 2003).

Diagnosis of Malnutrition

Malnutrition in hospitalized patients reflects the complex interaction between underlying diseases, disease-related metabolic alterations causing varying degrees of cachexia and reduced availability of nutrients because of reduced intake, impaired absorption and/or increased losses (Barker 2011). The diagnosis of malnutrition and risk of developing malnutrition in the hospital setting is usually be made using a validated nutrition assessment tool such as the Nutrition Risk Screening (NRS-2002) system. This system utilises components of the Malnutrition Universal Screening Tool (MUST) that assesses nutritional status (BMI, weight loss over 3-6 months, acute disease factors which influence nutritional intake for more than 5 days) and combines this with a subjective assessment of disease severity, based on increased nutritional requirements and metabolic stress, to indicate whether nutritional intervention is necessary (BAPEN 2003, Kondrup 2003).

6.2 Operational Aspects

**Initiation, duration and dose of TPN**

1. When indicated, initiation of TPN should occur after the resuscitation phase of acute illness has been completed. After this acute phase, a reasonable initial target for energy delivery is 20-25 kcal/kg/day based on ideal body weight (Krishnan 2003, Sena 2008, Taylor 1999, Martin 2004, Singer 2009, Casera 2011). Body weight should be adjusted for obese patients (ASPEN 2002, NICE 2006).

2. Elevated requirements up to 30-35 kcal/kg/day or greater may be indicated with states of increased stress and demand or in specific clinical situations (ASPEN 2002, NICE 2006).

3. The minimum duration for TPN to achieve a therapeutic benefit is 10-14 days.

**Referrals and management of TPN related issues**

1. During normal working hours, the Nutritional Support Team consists of the ICU Consultant, ICU Senior Registrar, Nutritional Support CNC, Dietitian and Pharmacist.

2. Consultations for ward patients regarding TPN related issues should be referred directly to a member of the Nutritional Support Team and a consultation form addressed to the ICU Consultant on duty for ICU-2 must be completed and inserted in the patient records. Key information in the referral and clinical notes must include:
   a. Diagnosis;
   b. The reasons why nutrition cannot be administered by the oral or enteral route;
   c. The expected duration of gastrointestinal dysfunction;
   d. Plans for medical and/or surgical management;
   e. The expected outcome/prognosis.

3. TPN referrals should be made during normal working hours and, except under exceptional circumstances, referrals will only be reviewed during normal working hours.
   a. Occasionally, the decision of whether to prescribe TPN is complex and additional opinions may be necessary (for instance, palliative care, gastroenterology or additional specialist opinion).
   b. **TPN is not routinely initiated on ward patients during weekends.**

4. Once TPN is commenced, the Nutritional Support Team will monitor the patient for the duration of this...
therapy. All TPN enquiries, orders and troubleshooting are to be directed to the Nutritional Support Team during normal working hours or to the ICU Registrar on duty for ICU-2 after hours. This includes the management of the central venous access device through which TPN is administered.

5. While routine TPN rounds will not be performed during weekends, the duty ICU-2 Registrar is available to review selected patients and should be contacted for matters related to TPN management at such times. It remains the responsibility of the admitting teams to review all patients during this time but the duty ICU-2 Registrar should be contacted if any changes relating to the TPN orders are deemed to be necessary.

6. TPN patients must be cared for by Registered Nurses.

6.3 Standard TPN Solution
The standard formulation currently in use at St. George Hospital is an “all-in-one” parenteral nutrition solution with a volume of approximately 2100 mL per bag. This should be prescribed as “TPN Standard” (Baxter Pharmacy System labelled as TPN Adult: Amino Acid ClinOleic Glucose [BXP SGH CN9.2EVT]).

Note: This solution contains electrolytes and has been preloaded by Baxter with multiple trace elements and iron (MTEFE) and multivitamins (except Vitamin K).

Presentation: All-in-one solution (as activated in triple chamber bag, vacuum sealed).
Expiry: Up to 90 days from the date of compounding (plus 24 hours at room temperature).
Storage: 2 – 8°C.

Notes:
1. The bags are delivered by Baxter “pre-mixed” (a segregated “3-in-1” bag is no longer used).
2. Once the bag has been removed from refrigeration and prepared for administration, the TPN solution expiry time is reduced to 24 hours. The TPN infusion must be discontinued and the bag discarded after 24 hours, regardless of the volume of any solution remaining.
3. Alternative formulations from Fresinius-Kabi (see table) and a lipid-free formulation from Baxter are available and, in some circumstances, these may be used in selected cases.

6.4 Standard TPN Solution: Preparation for Administration
The Baxter Standard TPN solution contains electrolytes, trace elements and vitamins in quantities designed to meet the basic requirement for most patients. Where necessary, additional electrolytes, trace elements and vitamins may be prescribed and added to the TPN solution (refer to 6.4.2).

6.4.1 Prescription of TPN
TPN is to be prescribed on a dedicated national inpatient medication chart (NIMC) separate from other drug prescriptions. It is prescribed as “TPN Standard” (or other formulation) with an appropriate rate of administration under dosage. Any changes to the rate of administration must be re-prescribed. Any modification (i.e. additives) to the TPN solution is to be prescribed under the direction of the Nutritional Support Team.
Additives that may be added to the Baxter Standard TPN solution include:
- Phosphate (all types)
- Potassium Acetate/Chloride
- Sodium Acetate/Chloride
- Magnesium Chloride/Sulphate
- Calcium Gluconate/Chloride
- Trace Elements with Iron (maximum additive: 10 mL of MTEFE)
- Vitamins (maximum additive: 5 mL or 1 vial of Cernevit)
- Folic Acid

Insulin, if required, is to be prescribed and administered as a separate infusion order (refer to 6.10).

### Maximum Limits of Electrolytes:

<table>
<thead>
<tr>
<th>Electrolytes*</th>
<th>Content per bag (mmol)</th>
<th>Maximum Additives per bag (mmol)</th>
<th>Total per bag (mmol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>70</td>
<td>290</td>
<td>360</td>
</tr>
<tr>
<td>Potassium</td>
<td>60</td>
<td>180</td>
<td>240</td>
</tr>
<tr>
<td>Magnesium</td>
<td>8</td>
<td>3.2</td>
<td>11.2</td>
</tr>
<tr>
<td>Calcium**</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Phosphate</td>
<td>30</td>
<td>10</td>
<td>40</td>
</tr>
</tbody>
</table>

* Includes Chloride 90 mmol, Acetate 107 mmol.
** No calcium can be added if inorganic phosphate is added.

6.4.2 Compounding of TPN
Where prescribed, additives (including extra vitamins and trace elements) have to be loaded in a suitable compounding facility arranged by hospital pharmacy. Loading of such additives shall not occur outside of a compounding facility with laminar flow where this can be performed under strict aseptic conditions. As such, no additives are to be loaded into a TPN bag on the ward or ICU. Loading of additives may take place on the same day of administration (except on weekends).
1. For same day administration, any modifications to the TPN prescription must be prescribed early (before 1pm) in order to facilitate same day delivery of the compounded solution.
2. For weekend administration, TPN solutions will be compounded and delivered on Friday.
3. All TPN solutions will be individually dispensed by pharmacy and labelled with patient ID.

Note: This applies to ward areas only. Standard TPN solutions will continue to be used in ICU.

6.4.3 Supplementary Fluids
In patients who experience extraordinary gastrointestinal losses (e.g. nasogastric, ileostomies, fistulae) supplementary fluids may be required in addition to electrolyte replacement. Additional crystalloids (and occasionally colloids) may be indicated in such circumstances and must be prescribed in consultation with the Nutritional Support Team.

6.5 Central Venous Access for TPN
1. Access for TPN is established through a centrally-inserted central venous access device (CICVAD) usually via the subclavian or internal jugular vein or alternatively via a peripherally-inserted central catheter (PICC).
2. CICVAD or PICC insertions are usually performed in ICU or by an Anaesthetist or Radiologist. A PICC may be also be inserted by the Nutritional Support CNC.
3. ECG monitoring is mandatory for insertion of the CICVAD.
4. ECG monitoring is recommended, but not mandatory, for PICC insertion: the PICC insertion technique does not require central placement of a guidewire thereby minimizing the risk of cardiac arrhythmia.
5. TPN should be administered via a volumetric infusion pump, NOT by gravity.
6. TPN should ideally be administered via a dedicated lumen that has not been used before. The dedicated
lumen should be documented in the patient’s notes. If a CICVAD/PICC is being placed, then consideration should be given to saving one of the distal lumens (by clearly labelling it) for TPN in the appropriate clinical context. Patient factors (such as haemodynamic instability, coagulation abnormalities, difficult venous access) may preclude safe placement of a new CICVAD/PICC and therefore it may not always be possible to insert a new line.

7. Catheter patency can be confirmed by a manual saline flush (not less than 10mL). The catheter should be gently aspirated to obtain flashback of blood prior to the administration of hypertonic solutions.

6.6 CICVAD and PICC Dressings
A semi-permeable, transparent dressing should be used at all times.

1. Catheter dressings must be changed using sterile technique weekly or as required:
   a. if blood, exudate or moisture are present under the dressing;
   b. if the dressing is loose or peeling;
   c. if the catheter is not firmly and securely supported by the dressing.

2. Catheter insertion site should be observed and documented each shift as follows:
   a. signs of redness, inflammation, ooze, pain or leakage;
   b. the catheter markings at skin level should be noted to monitor for catheter migration.

3. Chlorhexidine 2% in alcohol (70%) solution should be used to clean the insertion site. If the patient is allergic to chlorhexidine, Povidone iodine 10% in alcohol (70%) may be used. Allow to dry prior to dressing application.

4. Date the CVAD dressing and document site condition in the patient’s clinical notes.

6.7 Solution & Administration sets
1. TPN is typically administered as a continuous infusion over 24 hours.
2. The TPN solution bag must be changed after 24 hours, irrespective of the amount of residual TPN solution left in the bag.
3. TPN administration sets must be changed every 24 hours, with each bag change. Sterile technique, utilising dressing pack and sterile gloves when changing administration sets and bags, must be maintained. Chlorhexidine 2% in alcohol (70%) must be used with any manipulation of administration sets/connections.

4. Catheter patency should always be confirmed during a line change.
5. Label and date administration sets. Document the TPN dedicated lumen on handover and in the patient’s notes.
6. Administration sets attached to a CVAD should be safely secured to the patient so there is no tension applied to the catheter, dressing or sutures.
7. Needle-less access ports must be changed twice weekly (Monday and Thursday).
8. TPN should not be temporarily disconnected for transfers, mobilisation, showering, diagnostic imaging or other procedures. Interruptions to TPN can affect blood glucose and electrolyte levels as well as increase infection risk. Exceptions may be given for patients undergoing compression for cyclic TPN or ICU patients.
9. If disconnection occurs, TPN should be discarded and a new bag/line used on reconnection.

6.8 Monitoring of Patient receiving TPN
1. **Vital signs**: Temperature, pulse, blood pressure, respiratory rate and pulse oximetry **six-hourly**.
2. **Urinalysis for glucose** **six-hourly** for the duration of the parenteral feed. Once stable, this may be reduced to daily (consult the TPN team).
3. When glycosuria is present – perform a capillary blood glucose level (BGL).
4. Monitor patient’s **BGL** **four-hourly** during insulin infusion.
5. **Daily Electrolytes** (including Calcium, Magnesium, Phosphate) and **Liver Function Tests**.
6. **Daily Fluid Balance Chart**.
7. **Twice weekly Body Weight**.

**Note**: SEALS pathology will prioritize all TPN patients in ward areas in order to facilitate the review of the patient’s biochemistry during morning ward and TPN rounds. Accordingly, **all patients receiving TPN must be identifiable on request forms when routine tests are ordered**.
6.9 Problem Management

6.9.1 Infection
CICVADs or PICCs should be removed only if there are clinical signs of sepsis or if the exit site is inflamed or purulent. Catheter removal is also indicated in the presence of a positive paired cultures (from peripheral blood and blood drawn from the catheter) or positive culture of the catheter exchanged over a guide wire (Mermel 2009, Pittiruti 2009).

1. If the patient has a significant fever (usually >38.5°C and/or accompanied by rigors) AND there is a strong clinical suspicion of catheter-related sepsis (in the absence of another explanation for fever), notify the Nutritional Support Team or, if outside normal working hours, the ICU-2 Registrar.

2. If the CVAD or PICC is to be removed: a set of Quantitative Isolator Cultures (QICs) must be obtained firstly from a peripheral vein AND subsequently from each catheter lumen with each specimen labelled accordingly. The catheter tip must also be cultured.

6.9.2 Electrolyte Imbalance
1. The Nutritional Support Team (in ICU-2 and ward areas) will manage electrolyte imbalances.

2. Supplemental fluids and electrolytes may be prescribed with the TPN in consultation with the Nutritional Support Team.

3. If supplemental electrolytes are added to the TPN bag these must be preloaded in a compounding facility arranged by hospital pharmacy.

4. Typically, less than 10mmol/hr of Potassium is administered with the TPN. In exceptional circumstances, when indicated, this may be exceeded under the direction of the ICU Consultant.

6.9.3 Glycosuria
1. Usually tolerated for the initial 24 hours unless BGL > 15 mmol/L.

2. If BGL > 15mmol/L, reduce TPN infusion rate to 25 mL/hr and inform the Nutritional Support Team (during normal working hours) or the ICU-2 Registrar (outside normal working hours).

Note: On weekends, the ICU medical staff will not perform routine TPN rounds and admitting teams are responsible for reviewing their patients as usual. However, selected cases may be reviewed along with pathology results. Where problems occur or if changes relating to TPN are required, the duty ICU-2 Registrar must be notified.

6.10 Insulin Management during TPN

6.10.1 Insulin by infusion:
Following is the only method of insulin infusion to be used with TPN in ward areas and must be strictly adhered to.

INSULIN PRESCRIPTIONS:
For ward areas: GELOFUSIN 500 mL + ACTRAPID 100 units (Concentration = 0.2 unit/mL).
For ICU and ICU-2: 0.9% SALINE 50 mL + ACTRAPID 50 units (1.0 unit/mL).

REGIME:
Ideal BGL Range = 6-10 mmol/L:
• If BGL lies within this range, leave insulin infusion unchanged.

If BGL GREATER THAN 10 mmol/L:
• Increase insulin infusion rate by 1 unit/hr.
• Do not change rate again until next BGL check in 4 hours.
• CHECK BGL IN 4 HOURS
• If the BGL has not fallen to within the 6-10 mmol/L range (is still greater than 10mmol/L) increase insulin infusion rate by 1 unit/hr and repeat BGL after 4 hours.
If BGL LESS THAN 6 mmol/L:
- Decrease insulin infusion rate by 1 unit/hr.
- Do not change rate again until next BGL check in 4 hours.
- CHECK BGL IN 4 HOURS
  - If BGL has not increased to within the 6-10 mmol/L range (is still less than 6 mmol/L) reduce insulin infusion rate by 1 unit/hr and repeat BGL after 4 hours.
  - **If insulin is running at 1 unit/hr and BGL is less than 6 mmol/L STOP THE INSULIN INFUSION.**
- Re-check the BGL in 4 hours or earlier if clinically indicated.

DO NOT ADJUST THE TPN INFUSION RATE.

Notes:
1. Where vascular access is limited, insulin infusions may be piggybacked onto TPN provided a separate volumetric infusion pump is used.
2. BGL levels in the critically ill patient in ICU are monitored and treated in accordance to the patient condition and are typically carried out more frequently than in ward areas.
3. ICU administers insulin infusions via a syringe driver in accordance with unit guidelines. Prior to transfer to a ward area, the above prescription is to be ordered and implemented.

6.11 Discontinuation of TPN
TPN may be discontinued when enteral nutrition has been re-established either orally or via other enteric routes such as an enteral feeding tube or enterostomy. In general, when greater than 70% of nutritional requirements can be met by oral or enteral means TPN may be ceased completely.

It is not necessary to gradually wean patients from TPN (ASPEN 2002, Braga 2009).

Notes:
1. With current commercially available “3-in-1” solutions and change in practice to avoid high glucose loads, several small studies have demonstrated that even after abrupt discontinuation of TPN the plasma glucose returns to baseline pre-infusion levels within 60 minutes without risk of hypoglycaemia (Kryzwda 1993, Nirula 2000).
2. If the patient is not requiring insulin, the PN infusion rate may be decreased by 50% for 1-2 hours before ceasing.
3. Where patients are receiving an insulin co-infusion, greater care needs to be taken when ceasing TPN. If the PN infusion is ceased suddenly, a glucose infusion should be established and maintained for at least 12 hours after the insulin infusion is discontinued and the BGL monitored accordingly.
4. In patients with pre-existing diabetes mellitus, the patient’s usual diabetic medications including insulin and oral hypoglycaemic agents may need to be re-instituted prior to the discontinuation of TPN.

7. Compliance evaluation

Q: Who should you call for TPN related issues?
A: All TPN enquiries, orders and troubleshooting are to be directed to the Nutritional Support Team within normal working hours or to the ICU-2 registrar after hours. This includes the management of the central lines and PICC associated with TPN.

Q: What type of monitoring is required when a patient is receiving TPN?
A: Vital signs at least six-hourly, urine glucose six hourly, BGL four-hourly with insulin infusion, daily fluid balance chart, twice weekly body weight and daily blood chemistry including liver function tests.

Q: What type of insulin infusion can be used in ward patients receiving TPN?
A: GELOFUSIN 500 mL + ACTRAPID 100 units (Concentration: 0.2 unit/mL) titrated to a target BGL Range = 6-10 mmol/L.
8. Keywords

| “TPN”, “parenteral”, “nutrition” |

9. External references

|---|


### 10. Relevant committee approval

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision number</th>
<th>Contact Officer (Position)</th>
<th>Date for revision</th>
</tr>
</thead>
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<tr>
<td>July 2013</td>
<td>1</td>
<td>Andrew Cheng (ICU Consultant), Irena Martincich (CNC Nutritional Support)</td>
<td>July 2016</td>
</tr>
</tbody>
</table>

I, **Martin Mackertich**, attest that this business rule is not in contravention of any legislation, industrial award or policy directive.

### Revision and approval history